

Headquarters U.S. Air Force

Integrity - Service - Excellence

Air Force Total Ownership Cost (AFTOC)

Introduction to AFTOC



**N. Scott Belford
AFCAA/FMFT
31 January 2001**



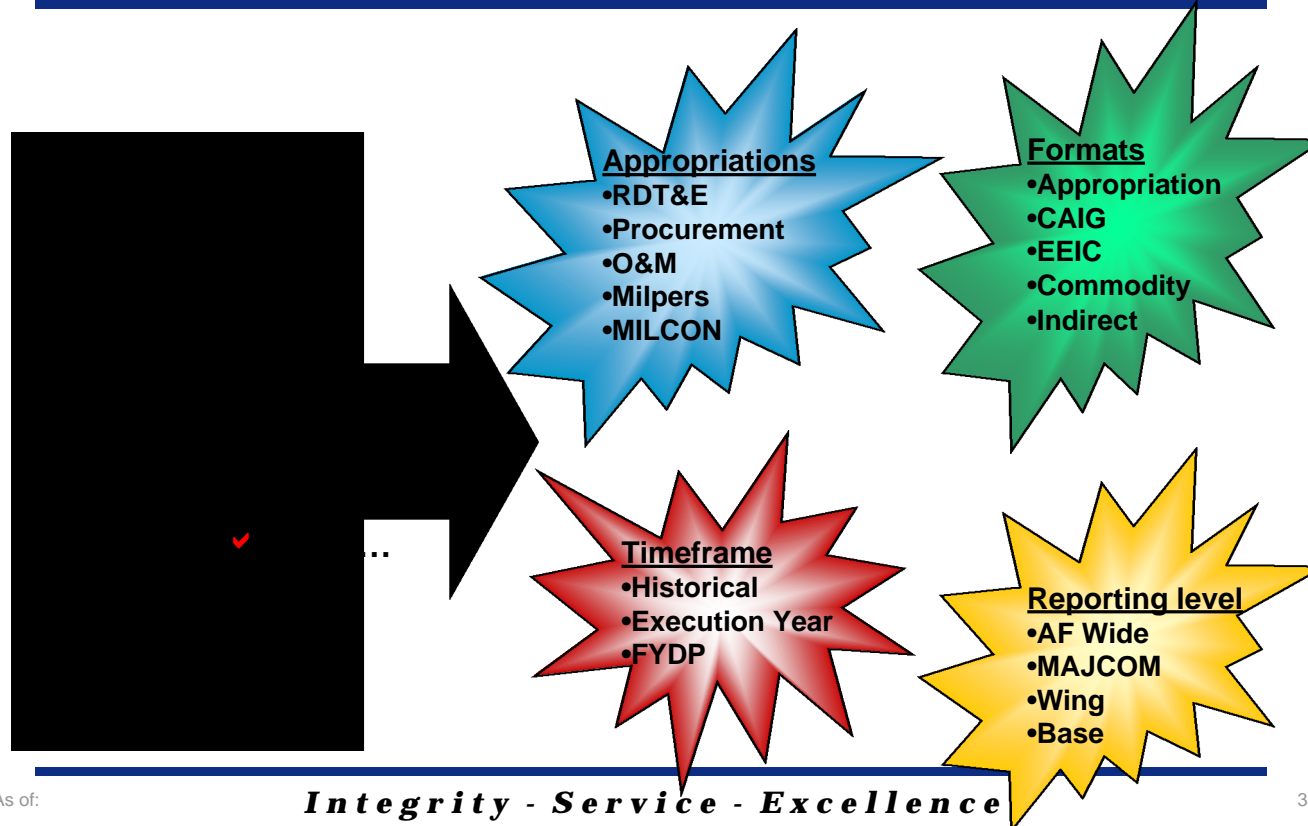
Purpose of AFTOC

- Provide routine, timely visibility into costs
 - Include all major Air Force systems
 - Include all appropriations and Major Commands
 - Report historical costs from actual obligations and outlays
 - Provide tool to implement R-TOC
- Be the primary tool chosen by leadership to assist in the management and control of Life-Cycle Costs



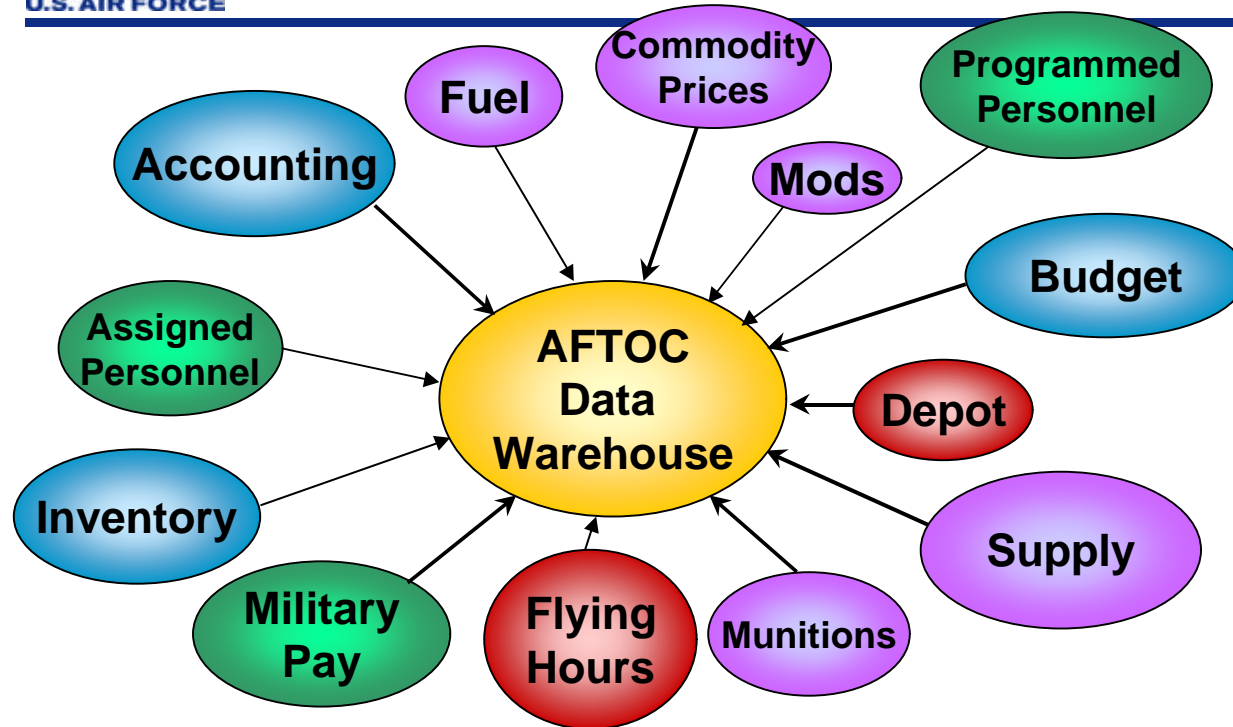
U.S. AIR FORCE

Scope: Breadth and Depth





AFTOC Data Sources



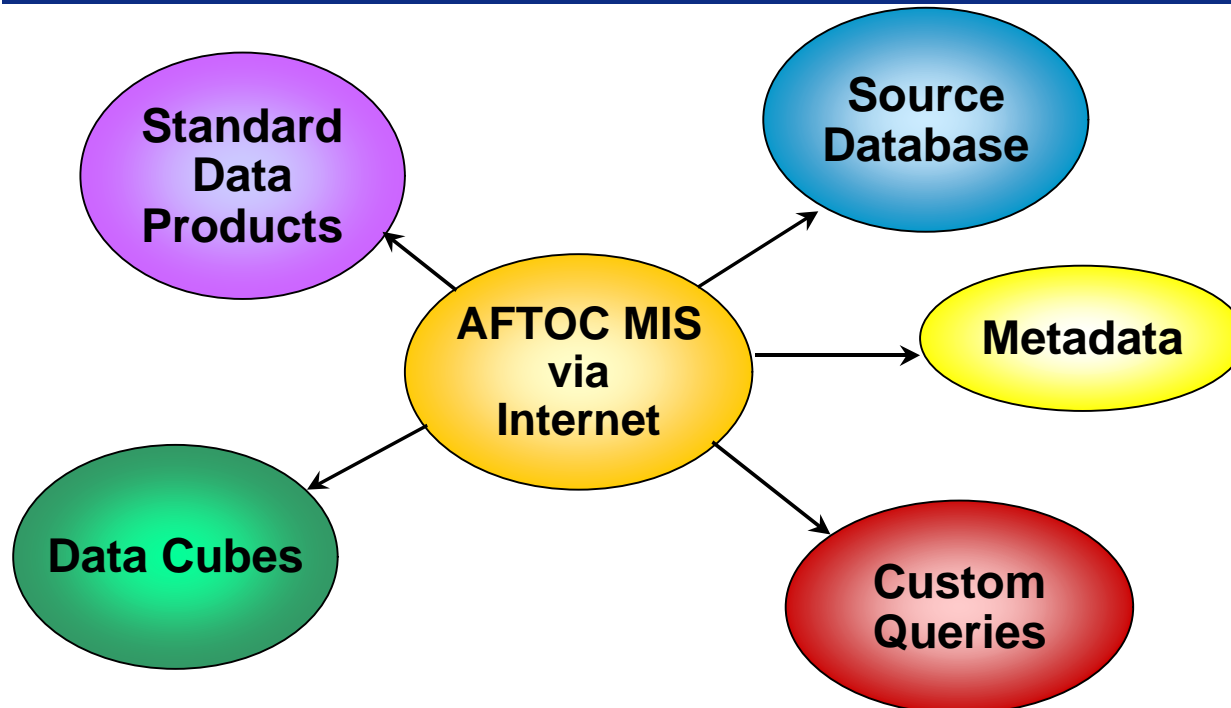
Single data repository for numerous sources AF-wide

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AFTOC Data Outputs



One-Stop Shopping for Air Force Cost Information



AFTOC Standard Products Formats

APPROPRIATIONS FORMAT

- 99% of Aircraft
- Most Space and Missile Systems and some Munitions
- Current and Historical Data Updated Quarterly
- FYDP Data Updated Annually
- Lowest Visibility - MAJCOM
- 00 PB and 01 PB Available

COMMODITIES FORMAT

- Searchable Database
- By MD/MDS
- By Commodity
 - Engines
 - Avionics
 - Hydraulics
 - Landing Gears
 - Weapons
- Lowest Visibility - Base/Wing (in CAIG format)
- FY98 - FY00 Data Available

CAIG FORMAT

- 99% of Aircraft
- Most Space and Missile Systems and many Munitions
- Follows OSD CAIG O&S Structure
- Updated Quarterly
- Lowest Visibility - Base/Wing
- FY96 - FY00 Data Available
- Average Inventory and Flying Hour Data Available
- Linked to Supply Transaction History

MUNITIONS FORMAT

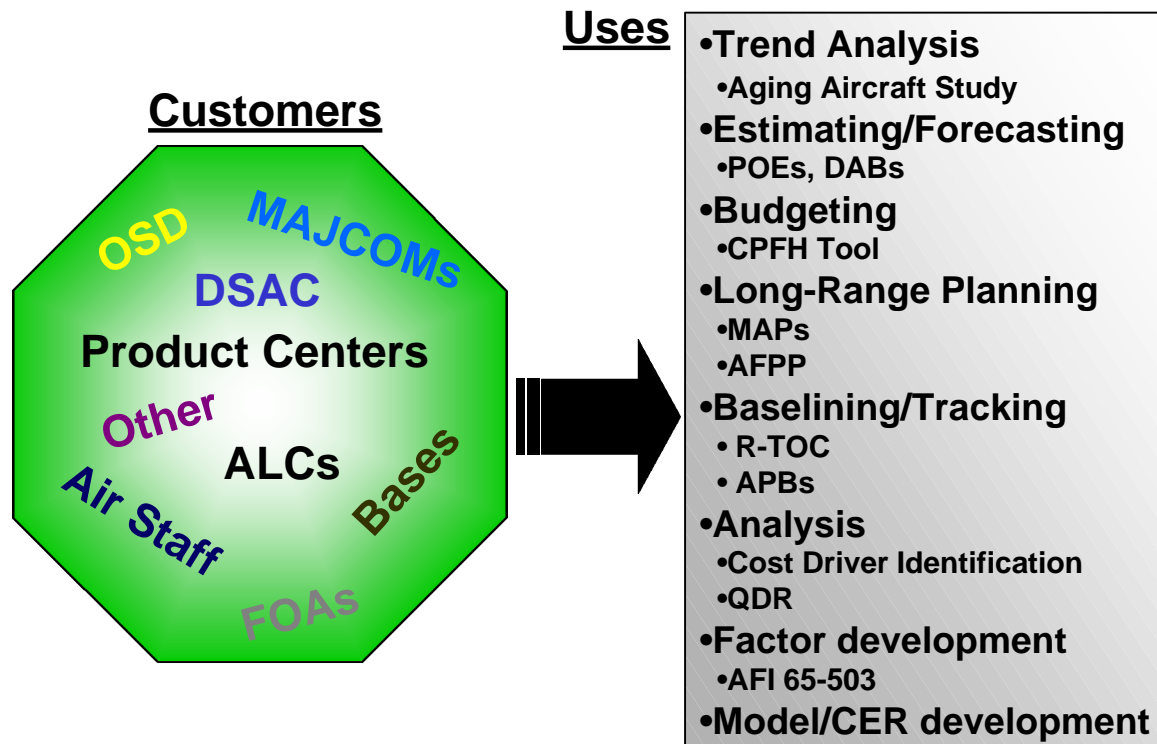
- From Combat Ammunition System
- Expenditure Data by Base/Wing
- Updated Quarterly
- FY96 - FY00 Data Available

INDIRECT FORMAT

- Definitions based on DFAS-DE 7000.1-R
 - Mission Ops
 - Supply Ops, etc
- Data Updated Quarterly
- Lowest Visibility - MAJCOM
- Data Available for FY 97 - FY 00



Application





Supports Broad User Base

- Program Manager
 - **Total Ownership Costs and R-TOC Baselines**
- Service and OSD Cost Analysts
 - **Historical Operating and Support Costs by Weapon System, Major Command, and Base**
- Comptroller
 - **Costs broken out by Element of Expense**
- Logistician
 - **Commodity cost data with National Stock Number detail**
- Base Commander
 - **Indirect Costs by Major Command and Installation**



How AFTOC Increases Productivity

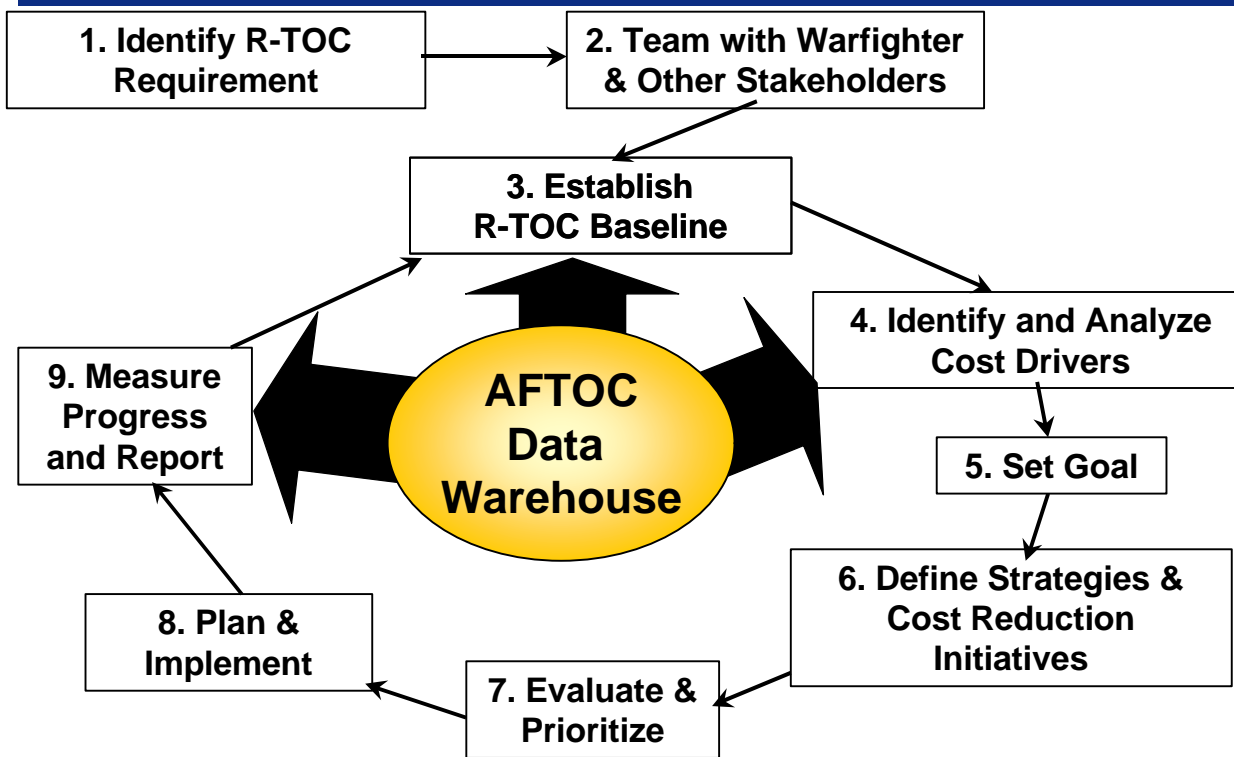
Example: Data Collection for Gen Ryan's Aging Aircraft Study

- **Effort prior to full AFTOC implementation**
 - **Requested data from several sources**
 - **Data normalized into similar terms and formats**
 - **Over one person-month to acquire and process data**

- **With full AFTOC deployment, same study took less than two person-days to get similar results**



RTOC Process





How Can You Use AFTOC?

U.S. AIR FORCE

Home Main Menu Help Search AFTOC

All AF
FY: [Current Fiscal Year] System: [Date of Run]
FY1990-04 FY-16C/D 01/3/99

Level 1 CAIG Level 2 CAIG Level 3 CAIG Cost per OpHr FH CPA
Inventory XLS

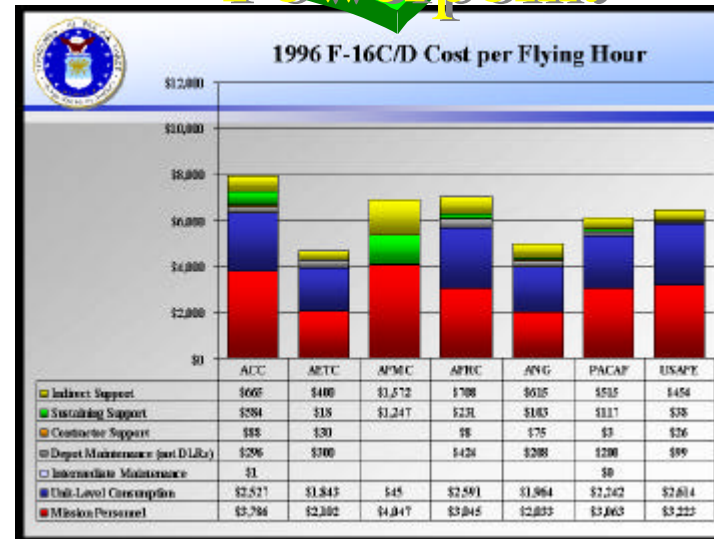
Level 1 Cost per OpHr

CAIG	CAIG Description	ACC	AETC	AFMC	AFRC	ANG	PACAF	USAF
1.0	Mission Personnel	\$2,595	\$2,238	\$5,374	\$2,195	\$2,207	\$3,626	\$3,053
2.0	Unit-Level Consumption	\$2,854	\$2,936	\$702	\$3,121	\$2,514	\$2,576	\$2,606
3.0	Intermediate Maintenance	\$3						
4.0	Depot Maintenance (not DLRs)	\$201	\$145		\$234	\$254	\$239	\$229
5.0	Contractor Support	\$70	\$35		\$8	\$65	\$8	\$10
6.0	Sustaining Support	\$496	\$16	\$555	\$172	\$102	\$34	\$25
7.0	Indirect Support	\$626	\$306	\$3,086	\$1,233	\$701	\$461	\$434
Ttl	Total Expenditures	\$7,774	\$5,676	\$10,051	\$6,565	\$5,545	\$8,946	\$6,455

Left sidebar: All CMDs, ACC, AETC, AFMC, AFRC, ANG, PACAF, USAF

Import it to
Powerpoint

Take data from
AFTOC



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11



Need Help?

- AFTOC Government Program Manager – Scott Belford
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email: scott.belford@pentagon.af.mil
- AFTOC Contractor Program Manager – Gary McNutt
phone: 703-604-0461 (DSN 664-0461)
email: gary.mcnutt@pentagon.af.mil
- AFTOC Password Questions/Problems – Bill Smith
phone: 703-602-9246 (DSN 332-9246)
email: william.d.smith@pentagon.af.mil.
- AFTOC Customer Service Representative – Ray Scheuring
phone: 703-604-0453 (DSN 664-0453)
email: ray.scheuring@pentagon.af.mil.



Summary

- Provides one-stop shopping for historical, current year, and FYDP cost information
 - Most comprehensive data on individual weapon systems available
 - Provides R-TOC baselines
- Uses latest technology to make data easily accessible to users via Internet

**Winner of FY1998 USD Comptroller Award for
Innovative Use of Technology to Improve Financial Mgt**



How AFTOC Increases Productivity

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Supports Broad User Base

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 - **Costs broken out by Element of Expense**
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AFTOC Uses

- **Reduction in Total Ownership Costs**
 - Provides system baselines
 - Commodities information produces R-TOC candidates
- **Quadrennial Review**
 - Develop wing level costs for Active/Reserve trade studies
 - Derive AFCAIG factors
 - Mid to long-range resource allocation analysis
- **Future Force Cost Analysis - FTF, AEF**
 - Derive baseline for “as-is” force structure



How AFTOC Increases Productivity

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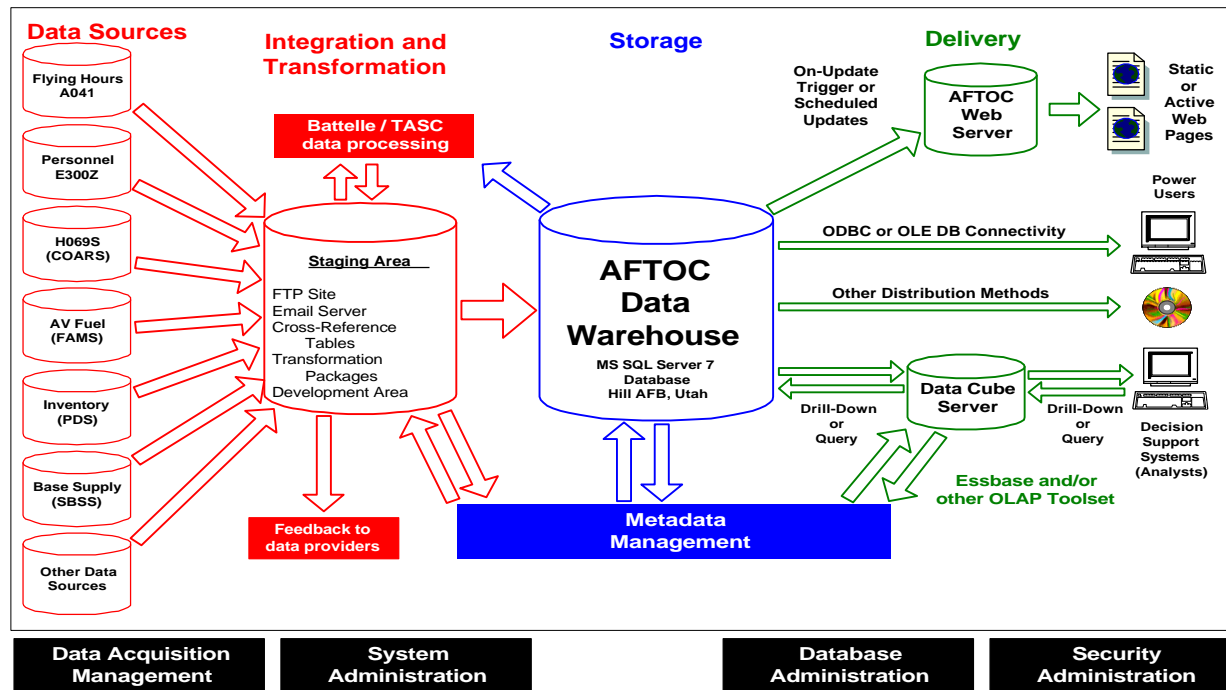
How to Access AFTOC

- Must have valid Username/Password to enter AFTOC.
 - AFTOC is a DOD system. If you are a DOD employee, a DOD support contractor, or a manufacturing contractor, complete the On-Line User Request Form at either www.aftoc.com or aftoc.hill.af.mil.
 - Fax an Authorization Letter from your government supervisor or sponsor to Mr. Bill Smith, DSN 664-6646 or commercial 703-604-6646. NOTE: you will be able to download an authorization Letter template after completing the user request form.



AFTOC Process

AFTOC Process Overview





USAF Fighter/Bomber Operating & Support Cost Estimating Relationship Development

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Gerrod Andresen
Cost & Affordability Analysis
Boeing - Phantom Works
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james.h.carlson@boeing.com

Introduction

***Purpose: Develop a Common O&S Cost Estimating Method
for Both USAF Fighter and Bomber Aircraft***

- ◆ **Cost Estimating Relationships (CERs) Developed for CAIG Level 2 O&S Cost Elements**
- ◆ **FY98 & FY99 Data for Ten Current USAF Aircraft**
 - **7 Fighters (1 Stealth)**
 - **3 Bombers (1 Stealth)**
- ◆ **Advanced Statistics Used**
 - **Fit and Predictive Measures**
 - **Dummy Variables**
- ◆ **Estimated Costs Compared Favorably to Actual Values**
- ◆ **CERs Incorporated Into CORE Model**
- ◆ **Compared AFTOC with CORE O&S Cost Estimate**

Fighter/Bomber O&S CER Development

INPUT DATA

- AFTOC
 - CAIG
 - Commodity
- REMIS
 - Failures, MA
 - MMH/FH
- AFI 65-503
 - SqN Manning
- SGR, FH

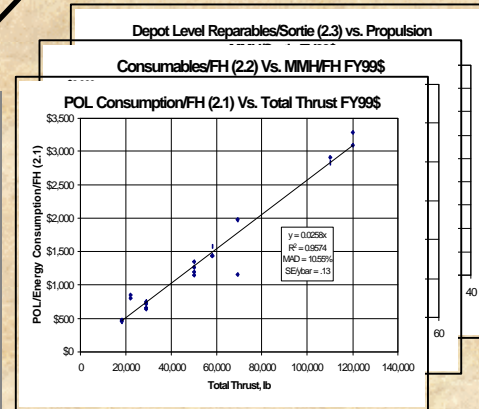
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COST ESTIMATING RELATIONSHIPS

- CAIG Level 2 Cost Elements
- Parametric CORE Model

REGRESSION ANALYSIS

- Excel
- CO\$TAT
- Advanced Statistics
 - Fit (R^2)
 - Predictive (MAD, SE)
 - Dummy Variables



Method Applied on Pulse Detonation Engine and Next Generation Bomber CRADs
Presented at Affordability Working Group Meeting and AFTOC User's Conference

Statistical Analysis Approach

- ◆ **CO\$TAT (Tecolote Research, Inc.) A Statistical Analysis Program Specifically for Cost & Technical Data**
- ◆ **Complex Linear, Log-Linear, and Non-Linear Analysis Using Dummy Variables**
- ◆ **Extensive Statistical Data Output**
 - **R^2**
 - **Mean Absolute Deviation (MAD)**
 - **Standard Error/ \bar{y}**
- ◆ **Excel Used for Simple Relationships**
 - **No Dummy Variables**

CAIG Level 2 Cost Elements

CAIG	CAIG Description
1.0	Mission Personnel
1.1	Operations
1.2	Maintenance
1.3	Other Mission Personnel
2.0	Unit-Level Consumption
2.1	POL/Energy Consumption
2.2	Consumables
2.3	Depot Level Repairs (DLR)
2.5	Other Unit Level Consumption
3.0	Intermediate Maintenance
3.3	Other Intermediate Maintenance
4.0	Depot Maintenance (not DLRs)

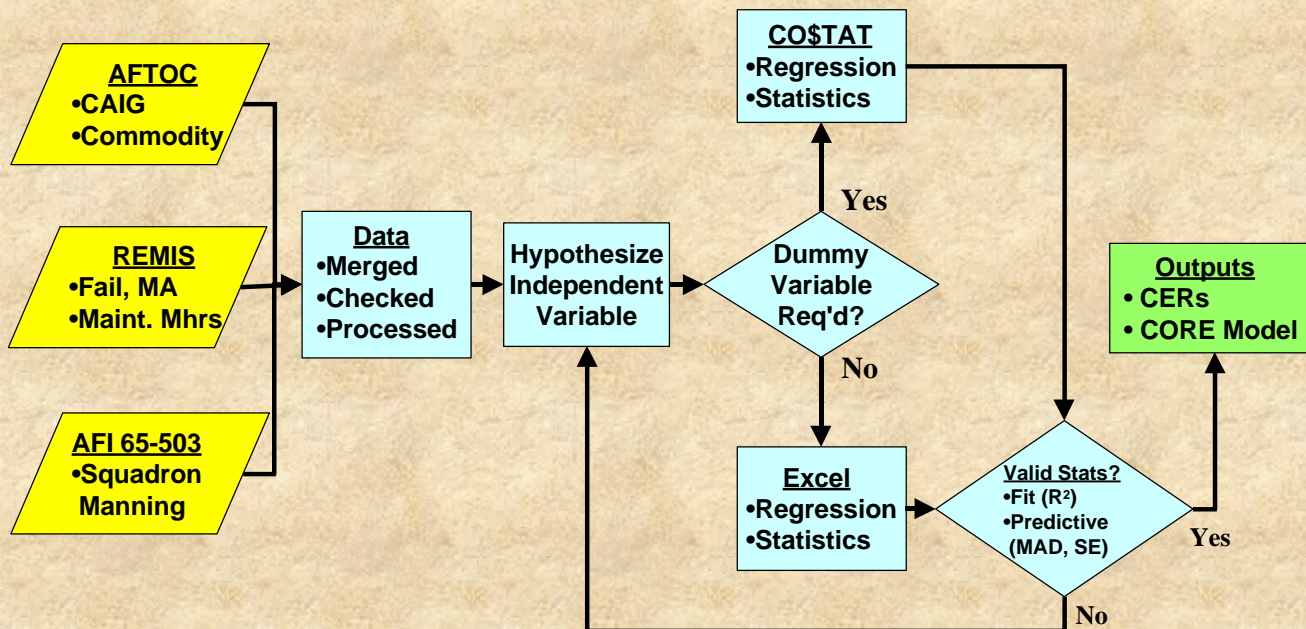
CAIG	CAIG Description
5.0	Contractor Support
5.1	Interim Contractor Support
5.2	Contractor Logistics Support
5.3	Other Contractor Support
6.0	Sustaining Support
6.1	Support Equipment Replacement
6.3	Other Recurring Investment
6.4	Sustaining Engineering Support
6.5	Software Maintenance Support
6.6	Simulator Operations
7.0	Indirect Support
7.1	Personnel Support
7.2	Installation Support

Aircraft Characteristics

Aircraft	Mission Category	Stealth	Crew	Crew Ratio (a)	Weight Empty	Total Thrust	No. Engines	Mach Number
B1B	Bomber	No	4	1.50			4	1.20
B2A	Bomber	Yes	2				4	High Sub
B52H	Bomber	No	5	1.40			8	0.86
F15C	Fighter	No	1	1.25			2	2.50
F15D	Fighter	No	2	1.25			2	2.50
F15E	Fighter	No	2	1.25			2	2.50
F16C	Fighter	No	1	1.25			1	2.00
F16D	Fighter	No	2	1.25			1	2.00
A10A	Fighter	No	1	1.50			2	0.56
F117A	Fighter	Yes	1				2	0.95

(a) Crew Ratios for B-2A and F117A account for Mission Planning Personnel.

CER Development Process



Aircraft Operational Data Summary AFTOC All Commands

Aircraft	FY1998			FY1999			Average		
	FH	Avg. Inv.	FH/ Aircraft	FH	Avg. Inv.	FH/ Aircraft	Avg. FH	Avg. Inv.	FH/ Aircraft
B1B	23,593	82.8	285.1	22,765	78.0	291.9	23,179	80.4	288.4
B2A	3,077	18.0	170.9	5,823	18.0	323.5	4,450	18.0	247.2
B52H	22,621	82.0	275.9	20,203	80.0	252.5	21,412	81.0	264.3
F15C	96,111	336.5	285.6	96,212	331.3	290.4	96,161	333.9	288.0
F15D	12,906	53.5	241.2	13,299	51.8	257.0	13,103	52.6	249.0
F15E	54,335	197.8	274.8	56,655	194.3	291.7	55,495	196.0	283.1
F16C	284,109	1,061.5	267.6	283,855	1,024.5	277.1	283,982	1,043.0	272.3
F16D	44,989	180.5	249.2	42,578	167.3	254.6	43,783	173.9	251.8
A10A	76,413	224.5	340.4	75,596	221.3	341.7	76,005	222.9	341.0
F117A	12,087	49.8	243.0	14,313	48.3	296.6	13,200	49.0	269.4
ALL	630,240	2,286.8	275.6	631,298	2,214.5	285.1	630,769	2,250.6	280.3

B2A Quantity Represents "PAA" Estimate, Including Aircraft in Modification

AFTOC CAIG Data O&S Cost/FH (FY99)

All Commands

CAIG	Aircraft	B1B	B2A	B52H	A10A	F117A
1.0	Mission Personnel	\$8,322	\$10,151	\$8,045	\$2,650	\$4,060
2.0	Unit-Level Consumption	\$13,240	\$5,307	\$6,461	\$2,104	\$1,750
3.0	Intermediate Maintenance	\$0	\$0	\$0	\$0	\$0
4.0	Depot Maintenance (not DLRs)	\$2,695	\$2,597	\$4,861	\$559	\$54
5.0	Contractor Support	\$214	\$1,842	\$383	\$10	\$14,009
6.0	Sustaining Support	\$4,461	\$16,122	\$2,368	\$214	\$12
7.0	Indirect Support	\$1,680	\$3,724	\$2,146	\$540	\$2,193
Total	Total Expenditures	\$30,610	\$39,743	\$24,265	\$6,077	\$22,078

CAIG	Aircraft	F15C	F15D	F15E	F16C	F16D
1.0	Mission Personnel	\$3,604	\$3,631	\$4,334	\$2,907	\$3,114
2.0	Unit-Level Consumption	\$5,881	\$6,318	\$7,526	\$2,953	\$3,118
3.0	Intermediate Maintenance	\$21	\$12	\$0	\$1	\$6
4.0	Depot Maintenance (not DLRs)	\$820	\$593	\$868	\$360	\$372
5.0	Contractor Support	\$60	\$50	\$178	\$49	\$49
6.0	Sustaining Support	\$158	\$173	\$39	\$242	\$212
7.0	Indirect Support	\$758	\$711	\$521	\$715	\$683
Total	Total Expenditures	\$11,302	\$11,487	\$13,465	\$7,226	\$7,555

AFTOC CAIG Data Average O&S Cost/FH (FY99) All Aircraft and Commands

CAIG	Aircraft	Avg.	% of Total
1.0	Mission Personnel	\$3,592	34.5%
1.1	Operations	\$681	6.5%
1.2	Maintenance	\$2,528	24.3%
1.3	Other Mission Personnel	\$383	3.7%
2.0	Unit-Level Consumption	\$4,267	41.0%
2.1	POL/Energy Consumption	\$949	9.1%
2.2	Consumables	\$607	5.8%
2.3	Depot Level Repairs (DLR)	\$2,571	24.7%
2.5	Other Unit Level Consumption	\$141	1.4%
3.0	Intermediate Maintenance	\$4	0.0%
3.3	Other Intermediate Maintenance	\$4	0.0%
4.0	Depot Maintenance (not DLRs)	\$747	7.2%

CAIG	Aircraft	Avg.	% of Total
5.0	Contractor Support	\$407	3.9%
5.1	Interim Contractor Support	\$0	0.0%
5.2	Contractor Logistics Support	\$391	3.8%
5.3	Other Contractor Support	\$16	0.2%
6.0	Sustaining Support	\$565	5.4%
6.1	Support Equipment Replacement	\$33	0.3%
6.3	Other Recurring Investment	\$3	0.0%
6.4	Sustaining Engineering Support	\$221	2.1%
6.5	Software Maintenance Support	\$308	3.0%
6.6	Simulator Operations	\$1	0.0%
7.0	Indirect Support	\$823	7.9%
7.1	Personnel Support	\$23	0.2%
7.2	Installation Support	\$800	7.7%
Total	Total Expenditures	\$10,407	100.0%

Analysis of AFTOC Commodities Data

- ◆ **Use FY1998 and FY1999 CAIG and Commodities**
- ◆ **Determine FH from CAIG Data**
- ◆ **Commodities Data (Net Cost) for Each Aircraft**
 - **FY1998 and FY1999**
 - **Allocate to Avionics, Engine, and Other using Federal Stock Code**
 - **Determine \$/FH and % Allocation**
- ◆ **Omit B2A FY1999 Commodities Data**
 - **Net Avionics Cost is Negative**
- ◆ **Relate to CAIG Total AVDLR**

**AFTOC Commodities Data
(FY98 and FY99 Combined)**

Data Deleted

AFTOC DLR & Commodities Comparison (FY98 and FY99)

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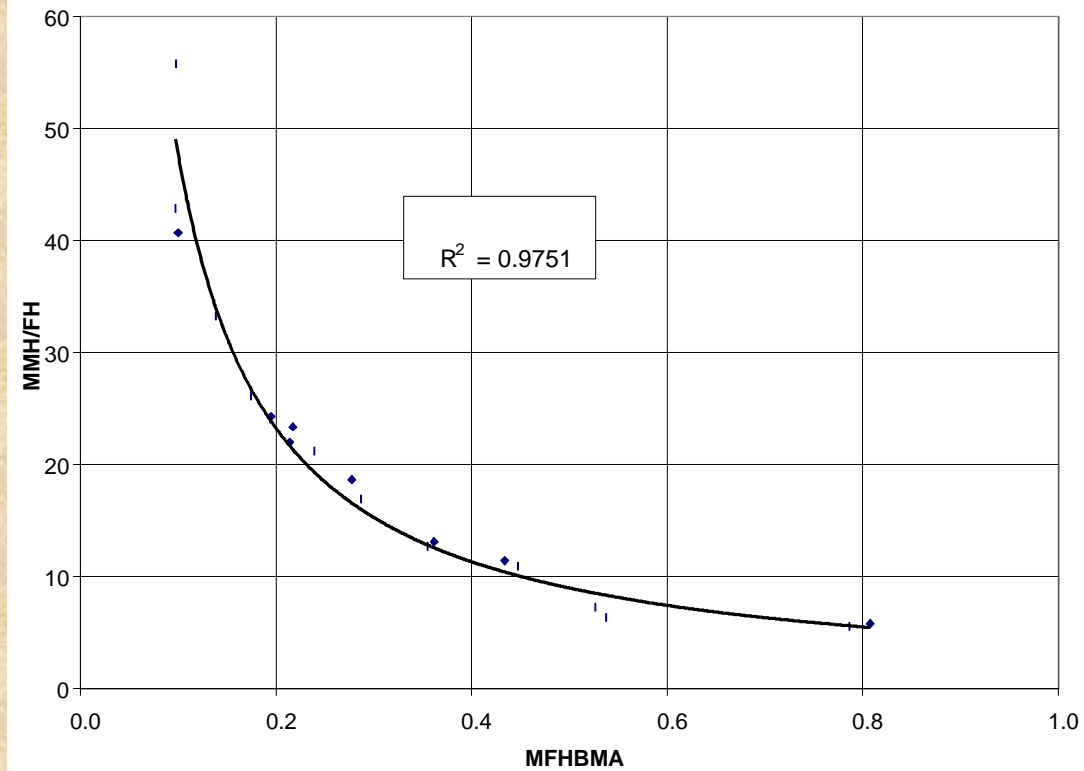
Reliability and Maintainability (REMIS) Data

- ◆ **Used FY1998 and FY1999 Data**
- ◆ **Obtained Operational and R&M Data**
 - **FH, Sorties, Average Inventory**
 - **MMH/FH, MFHBF, and MFHBMA**
 - **Unscheduled On & Off Aircraft, Support General**
 - **Regular Forces**
- ◆ **Allocated R&M to Avionics, Propulsion, Structure, and Subsystems by 2-Digit Work Unit Code**

REMIS R&M Data (FY99)
Operational Commands

Data Deleted

REMIS R&M Data (FY98 & FY99)



Fighter/Bomber O&S CER Development

CAIG	CAIG Description	Basis	Independent Variable	Percent (FY99)	Other	
					Ftr/Bomb	Stealth
1.0	Mission Personnel			34.52%		
1.1	Operations	/AC	Crew Ratio, PAA	6.55%		
1.2	Maintenance	/AC	MMH/FH, Surge Sortie Rate	24.29%		
1.3	Other Mission Personnel	/AC	AFI 65-503 Staff	3.68%		
2.0	Unit-Level Consumption			41.01%		
2.1	POL/Energy Consumption	/FH	Aircraft Total Thrust	9.12%		
2.2	Consumables	/FH	MMH/FH	5.83%		
2.3	Depot Level Repairs (DLR)	/FH	Propulsion MMH/Sortie	24.70%		
2.5	Other Unit Level Consumption	/FH	Maint Pers Cost (1.2)	1.35%	X	X
3.0	Intermediate Maintenance			0.04%		
3.3	Other Intermediate Maintenance	/FH	No CER	0.04%		
4.0	Depot Maintenance (not DLRs)	/FH	MMH/FH	7.18%		
5.0	Contractor Support			3.91%		
5.1	Interim Contractor Support	/AC	No CER	0.00%		
5.2	Contractor Logistics Support	/AC	No CER	3.76%		
5.3	Other Contractor Support	/AC	MMH/FH	0.16%		X
6.0	Sustaining Support			5.43%		
6.1	Support Equipment Replacement	/AC	MMH/AC/Yr	0.32%	X	
6.3	Other Recurring Investment	/AC	No CER	0.02%		
6.4	Sustaining Engineering Support	/AC	Depot Maint/FH	2.13%		X
6.5	Software Maintenance Support	/FH	Maint Cost/FH	2.96%	X	
6.6	Simulator Operations	/AC	No CER	0.01%		
7.0	Indirect Support			7.90%		
7.1	Personnel Support	/AC	Miss Pers Cost/AC (1.0)	0.22%	X	
7.2	Installation Support	/AC	Miss Pers Cost/AC (1.0)	7.69%		X
			CERs Developed	96.17%		
			CERs not Developed	3.83%		

Analysis of Squadron Manning

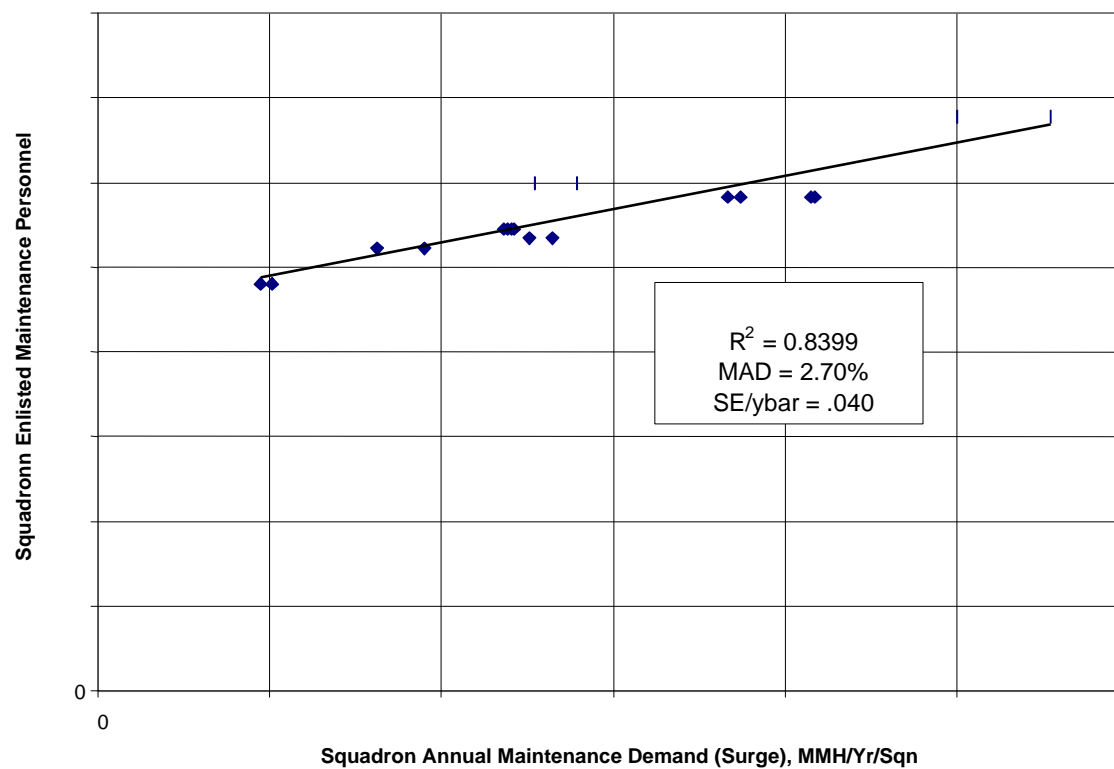
- ◆ **Squadron Manning from AFI 65-503 Table 42-1**
 - **ACC**
- ◆ **Apply Operational FH and Sorties**
- ◆ **Assume Surge Sortie Rates for Bombers and Fighters (XX and YY)**
- ◆ **Total MMH/FH (Unsched & Supt. General)**
- ◆ **Determine “Surge” Squadron Annual Maintenance Demand (AMD)**
 - **$AMD = AC/Sqn * FH/AC/Yr (Surge) * MMH/FH$**
- ◆ **Relate to Enlisted Maintenance Personnel**

USAF Typical Squadron Manning (ACC)
AFI 65-503 Table 42-1

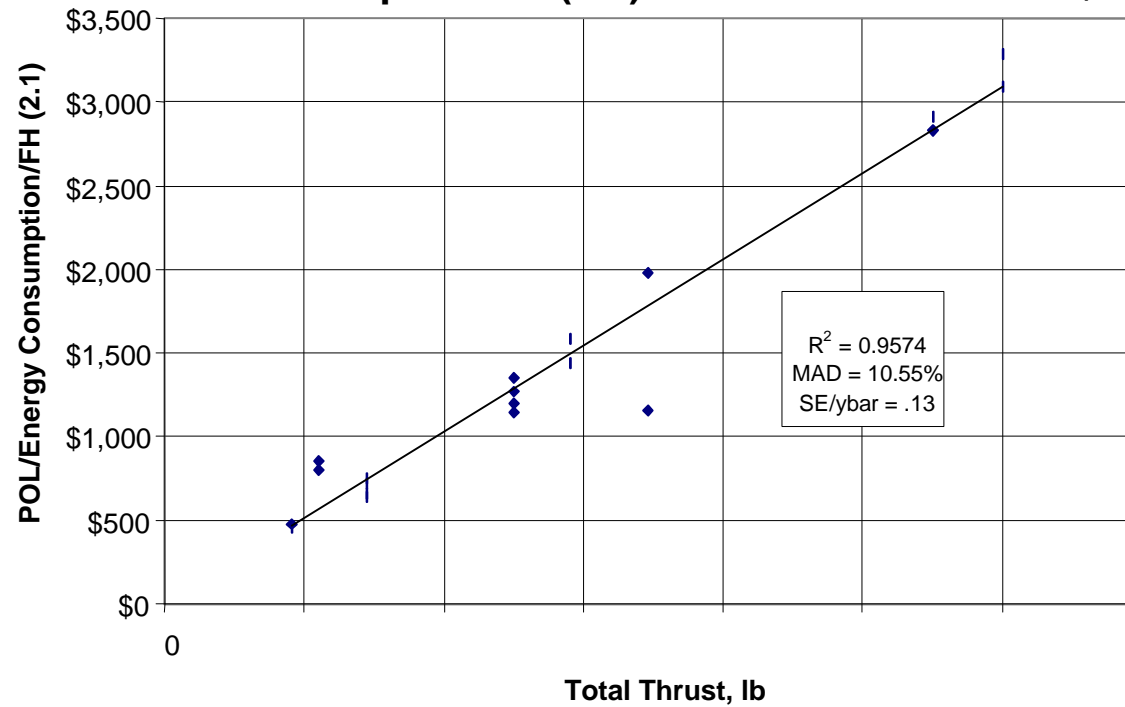
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Enlisted vs. Maintenance Manhour Demand

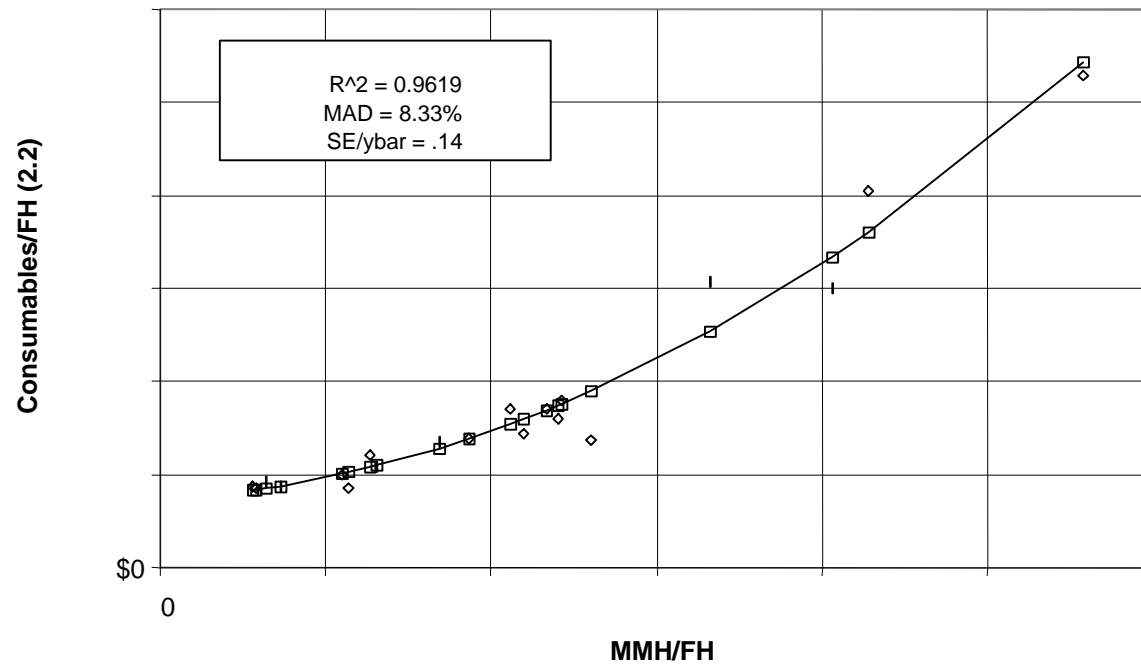
ACC ~ Surge FY98/99 (3.0 (Fighter) and 0.7 (Bomber) Sorties/Day)



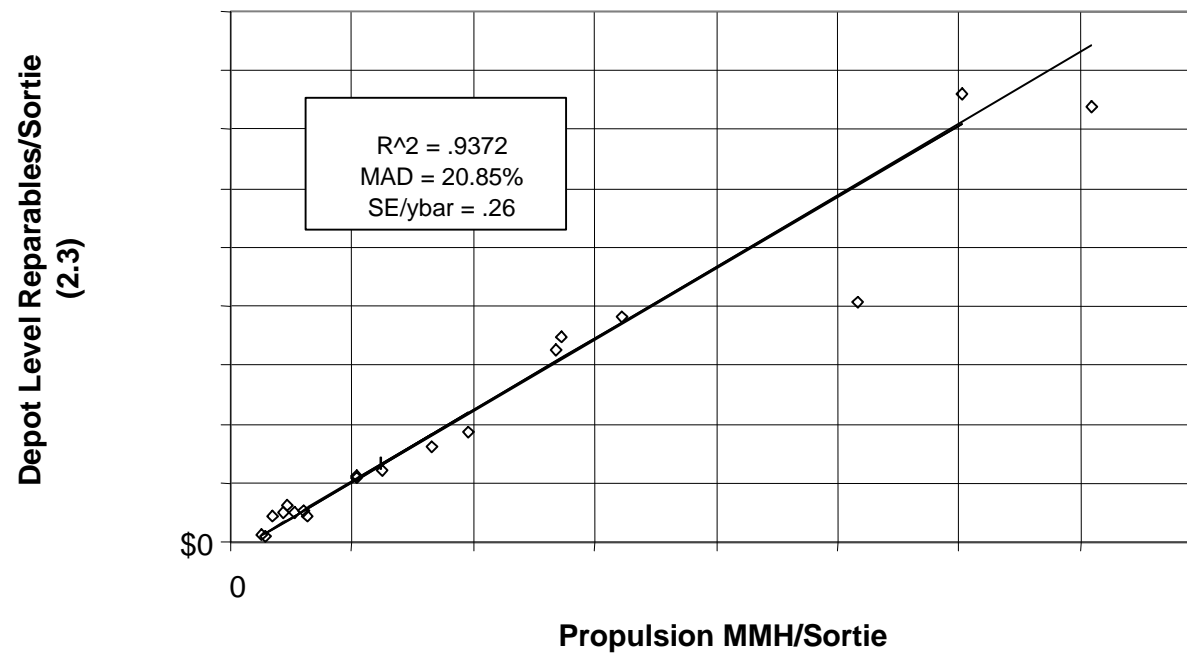
POL Consumption/FH (2.1) Vs. Total Thrust FY99\$



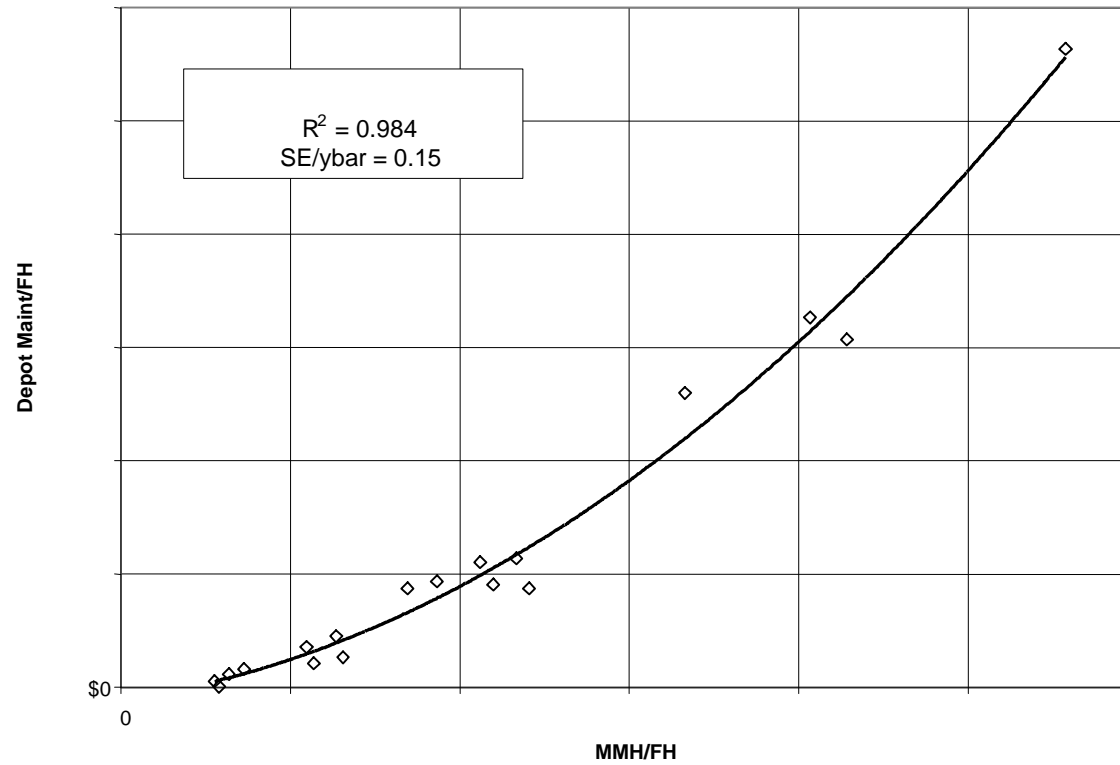
Consumables/FH (2.2) Vs. MMH/FH FY99\$



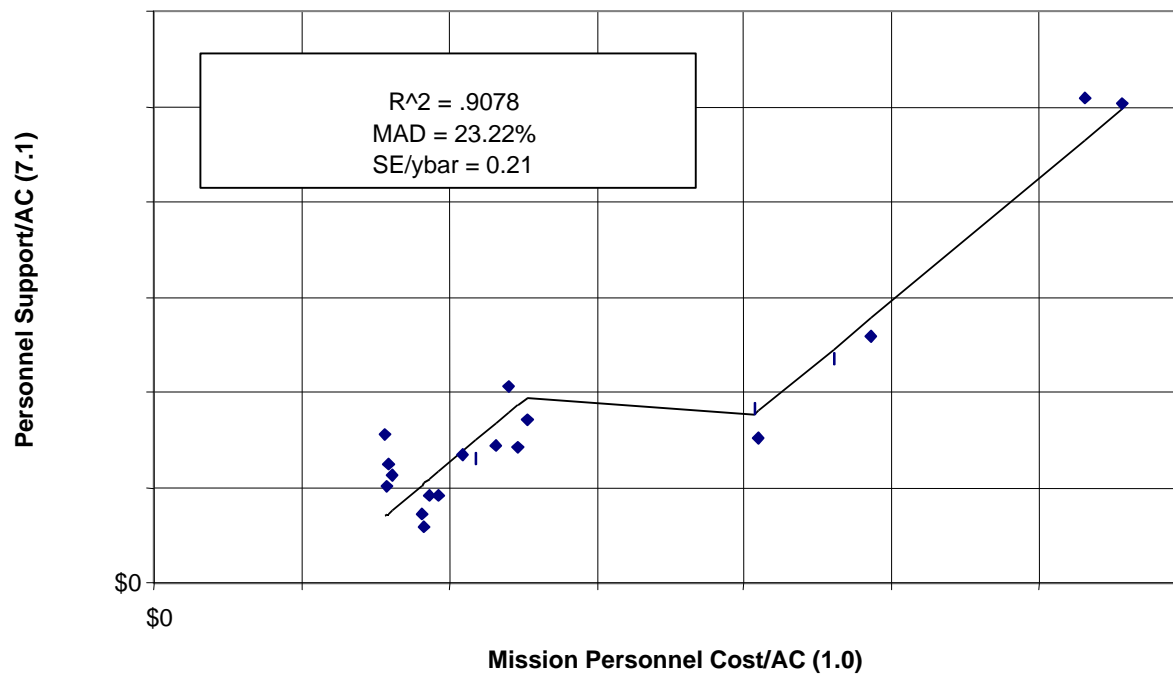
Depot Level Repairables/Sortie (2.3) vs. Propulsion MMH/Sortie FY99\$



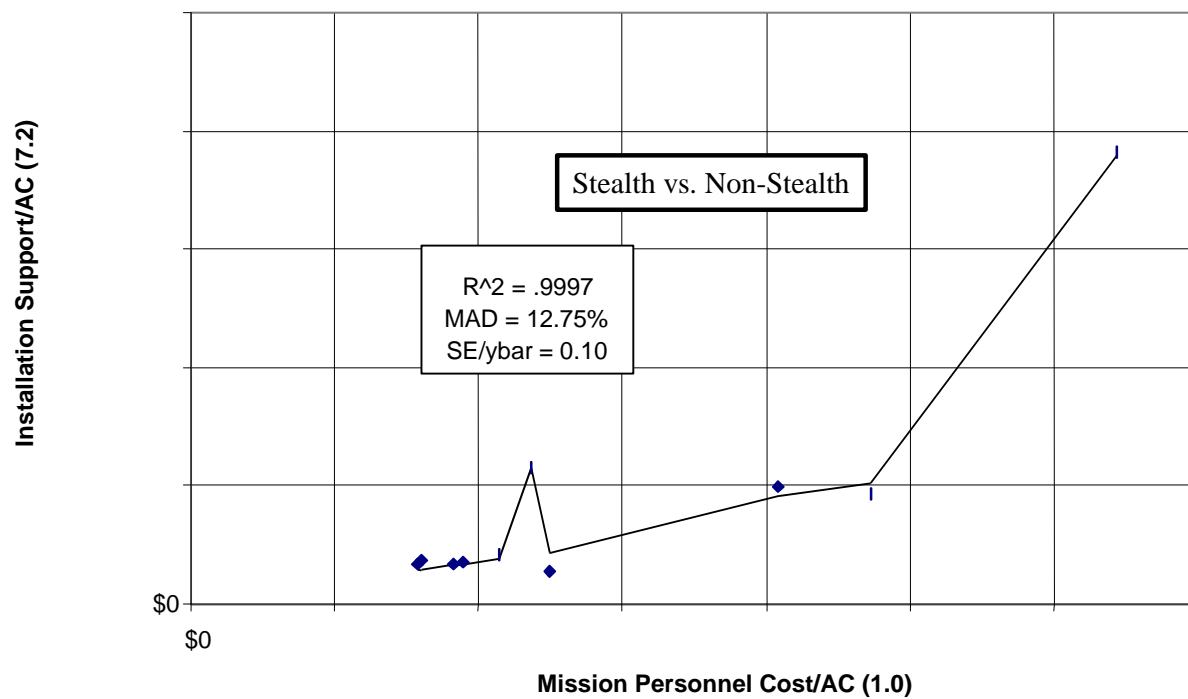
Depot Maintenance/FH (4.0) vs. MMH/FH ~ FY99\$
Excludes B52

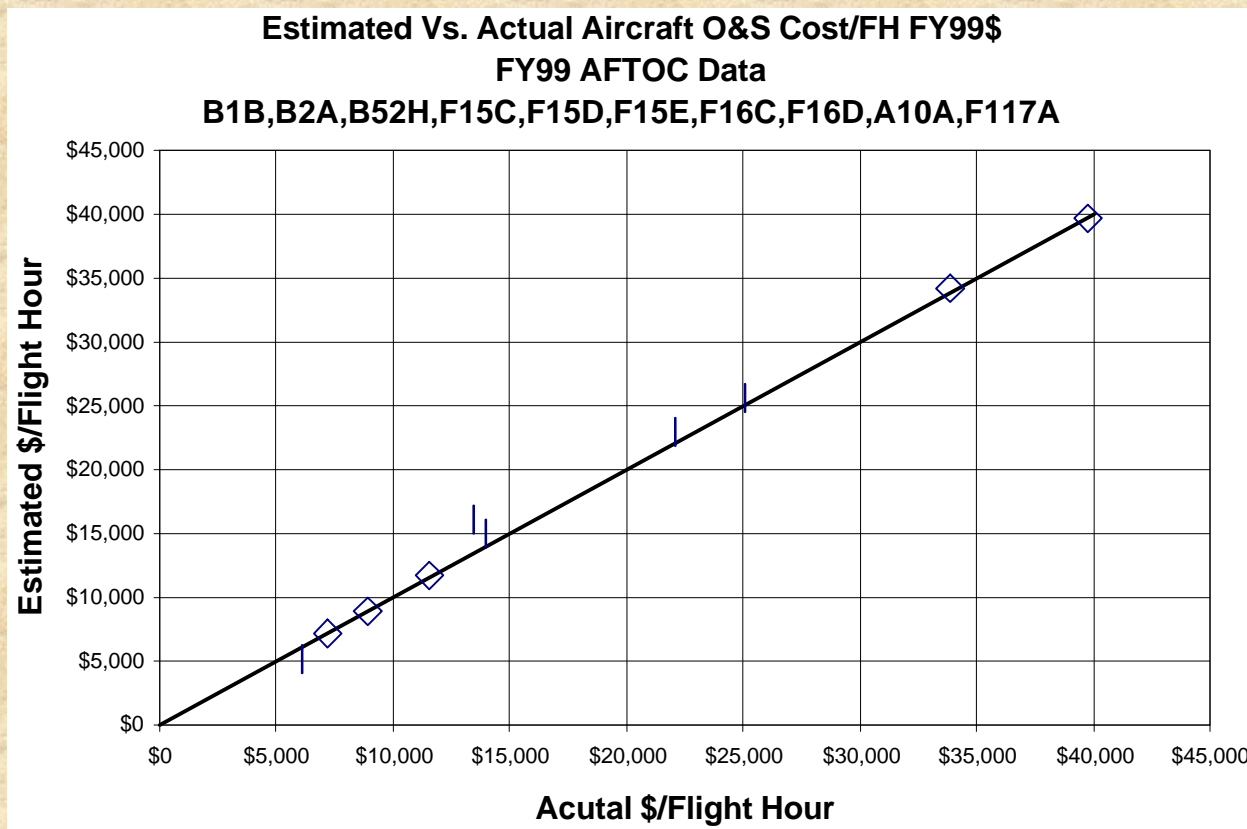


Personnel Support/AC (7.1) Vs. Mission Personnel Cost/AC (1.0) FY99\$ (Fighter & Bomber Separate)



**Inst. Supt/AC (7.2) vs. Mission Person. Cost/AC (1.0) FY99\$
Combined FY98 & FY99 Data**





Fighter/Bomber Parametric CORE Model

- ◆ **User Inputs**
 - **Operational Data**
 - **Maintenance Data**
- ◆ **AFI 65-503 Inputs**
 - **Pay and Allowance**
 - **Turnover Rates**
 - **Training Costs**
- ◆ **Cost Estimating Relationships**
 - **22 Boeing Developed**
 - **1 USAF Developed (Class IV Mods)**

Parametric CORE Model vs. AFTOC CAIG Data FY99 B1B ACC

CAIG	Cost Element	CORE \$/FH	AFTOC \$/FH	% Difference
1.0	Unit Mission Personnel	\$9,167	\$8,985	2.0%
1.1	Operations	\$1,819	\$1,990	-8.6%
1.2	Maintenance	\$5,924	\$6,493	-8.8%
1.3	Other Mission Personnel	\$1,424	\$502	183.9%
2.0	Unit Level Consumption	\$15,552	\$14,196	9.6%
2.1	POL/Energy Consumption	\$3,096	\$3,030	2.2%
2.2	Consumable Materials/Repair Parts	\$1,801	\$2,022	-10.9%
2.3	Aviation Depot Level Reparables	\$10,463	\$9,011	16.1%
2.4	Training Munitions/Expendable Stores	\$53	\$0	-
2.5	Other (Unit Level TDY, Eq Rental, etc.)	\$139	\$133	4.5%
3.0	Intermediate Maintenance	\$0	\$0	-
3.3	Other Intermediate Maintenance	\$0	\$0	-
4.0	Depot Maintenance	\$3,453	\$3,071	12.4%
5.0	Contractor Support	\$180	\$238	-24.4%
5.1	Interim Contractor Support	\$0	\$0	-
5.2	Contractor Logistics Support	\$180	\$219	-18.0%
5.3	Contractor Software Maintenance	\$0	\$18	-100.0%
6.0	Sustaining Support	\$6,062	\$5,687	6.6%
6.1	Support Equipment Replacement	\$70	\$73	-4.3%
6.2	Modification Kit Procurement/Installation	\$1,919	\$0	-
6.4	Sustaining Engineering Support	\$816	\$927	-12.0%
6.5	Software Maintenance Support	\$3,258	\$4,687	-30.5%
6.6	Simulator Operations	\$0	\$0	-
7.0	Indirect Support	\$2,175	\$1,706	27.5%
7.1	Personnel Support	\$1,467	\$60	2353.9%
7.2	Installation Support	\$708	\$1,646	-57.0%
	Total O&S Cost	\$36,590	\$33,882	8.0%

- Security Personnel Included in Other Mission Personnel in AFTOC and Installation Support in CORE
- Training Munitions Costs Not Included in AFTOC
- Modification Kit Procurement/Installation Not Included in AFTOC
- Training Costs Not Included in AFTOC Personnel Support Cost

Summary

- ♦ **AFTOC, REMIS, and AFI 65-503 Data Used to Develop CERs for CAIG Level 2 O&S Cost Elements**
- ♦ **CERs Developed for Cost Elements Including over 95% of O&S Cost**
- ♦ **More Statistically Relevant CERs Than Those Previously Developed**
- ♦ **Estimated Results Compare Closely to Actual AFTOC CAIG Data**
- ♦ **CERs Incorporated Into CORE Model for Estimating Future USAF Fighter and Bomber Aircraft**

Recommendations for AFTOC

- ♦ **Include Personnel Quantities and Pay Rates in CAIG Data Summaries**
- ♦ **Investigate Negative Net Costs for Certain Commodities**
- ♦ **Incorporate Capability to Pull MDS R&M Data**